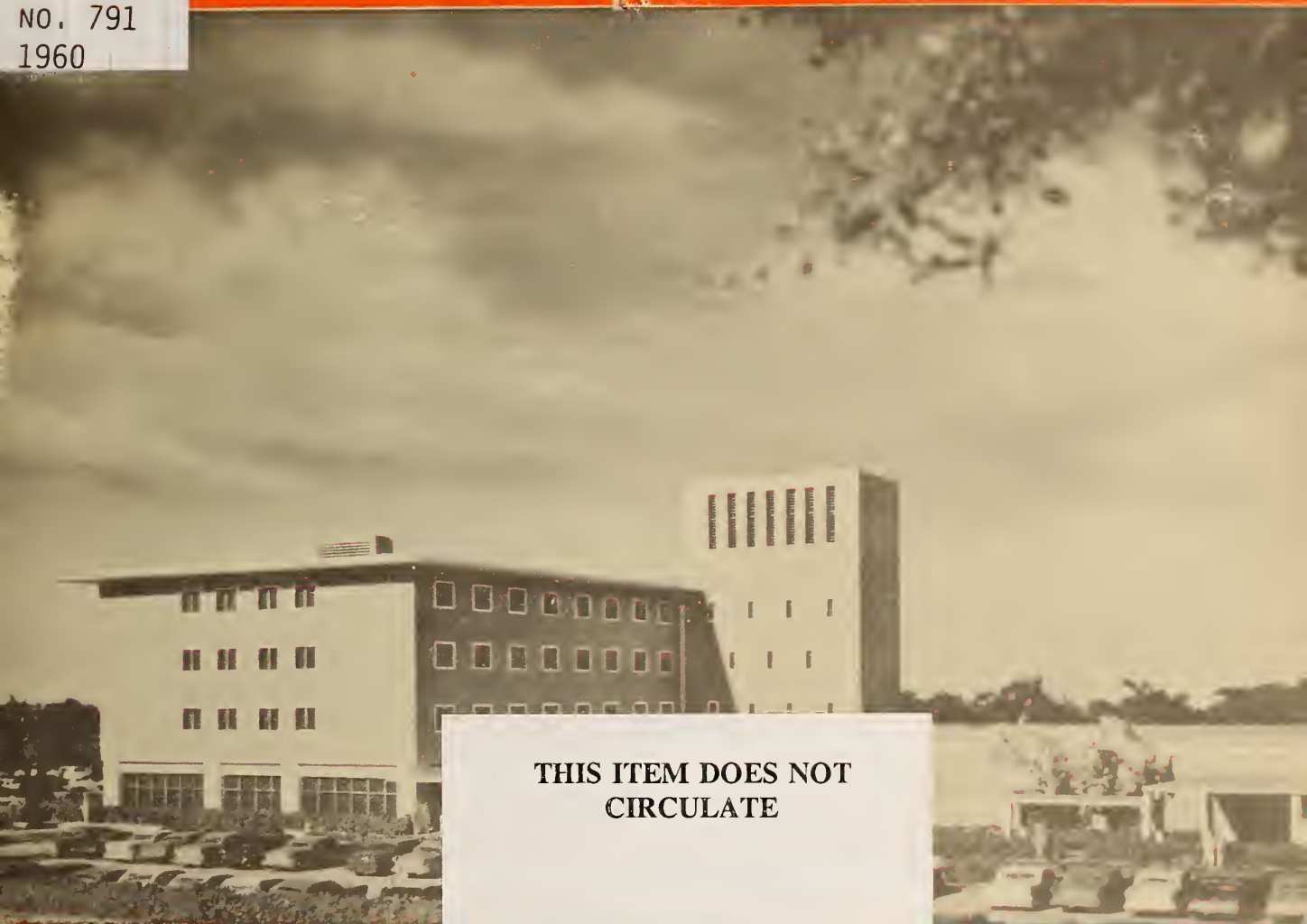


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1960



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PROTOTYPE HOSPITAL - FALLOUT PROTECTED



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

**PROTOTYPE HOSPITAL:
FALLOUT PROTECTED**

**Prepared by
Architectural and Engineering Branch**

**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Hospital and Medical Facilities**



FOREWORD

This publication reports a study of recognized fallout radiation protection design measures as applied to hospitals. The implications of chemical and biological contaminants were also studied and are included as part of this report. The primary purpose of this study is to develop criteria and standards for the protection of hospital patients, personnel and vital functional components compatible with normal functional planning and efficient day-to-day operation. It is hoped that this information will also encourage the development of integrated community civil defense plans in which the potentialities of the local hospital are fully utilized.

Detailed design criteria and other technical information on incorporating fallout shelter in new hospital buildings and in additions to existing hospital buildings are being prepared.

This project is an activity of the Hill-Burton Program of the Public Health Service, developed by the Architectural and Engineering Branch of the Division of Hospital and Medical Facilities under a grant from the Office of Civil and Defense Mobilization.

A handwritten signature in cursive script that reads "Jack C. Haldeman".

Jack C. Haldeman, M.D.
Assistant Surgeon General
Chief, Division of Hospital
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August 1960

IV

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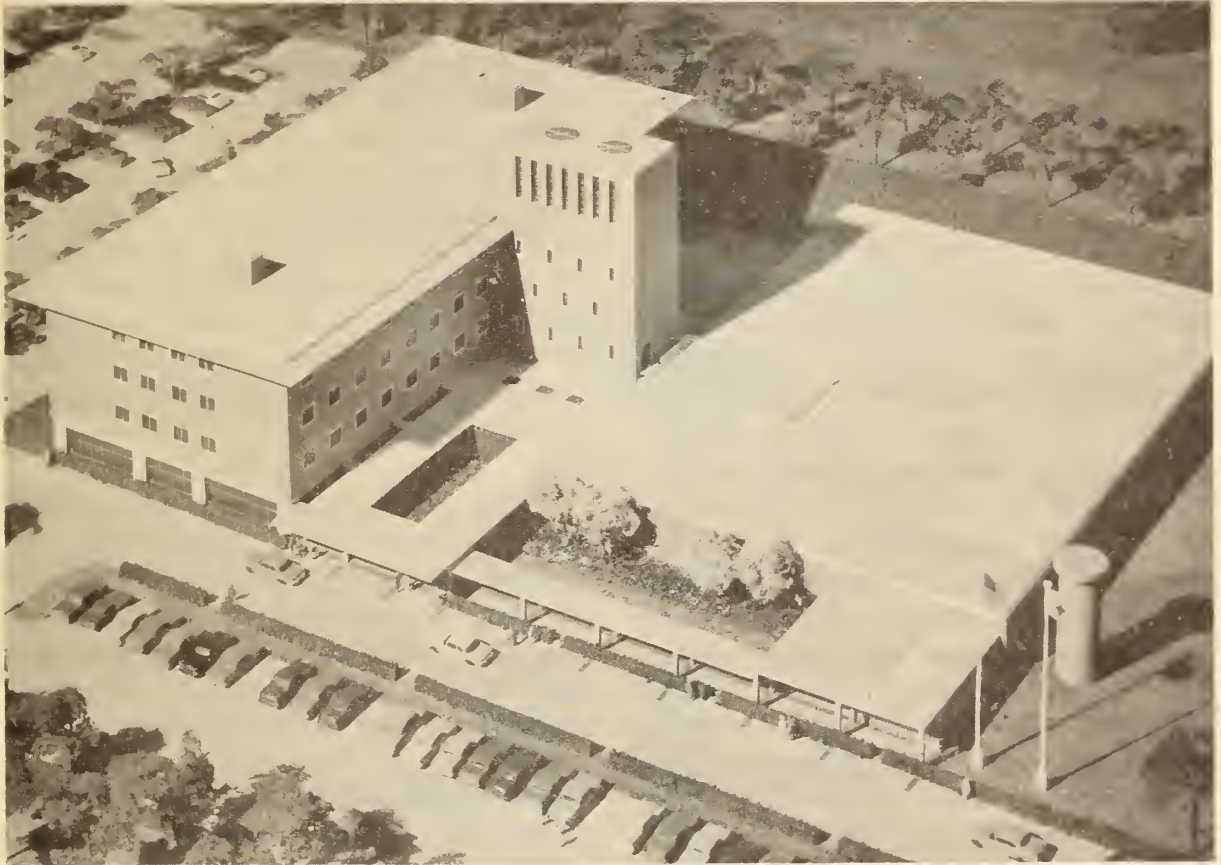
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PROTOTYPE HOSPITAL— FALLOUT PROTECTED



THE NEED FOR PLANNING PROTECTION

The Public Health Service has, for a number of years, been conscious of the responsibility hospitals have to the community over and beyond those health problems which arise during the course of everyday living. Meeting these usual health needs is, indeed, a formidable task in itself and a hospital might feel justifiable pride in successfully accomplishing

this objective. However, it is in time of disaster when the services and skills which the hospitals represent are most urgently needed. For the hospital to come forth at this time with the means by which it could be the focal point for getting medical care, shelter and comfort to the sick and injured would be the expression of its fullest purpose.

A number of hospitals have, on occasion, successfully met the demands of natural and man instigated disasters because they were prepared to do so, and thus had earned the gratitude of the citizenry. These experiences have created a stockpile of knowledge from which excellent guidelines for disaster planning have been developed.

More complex however, is the situation with regard to nuclear warfare. Here again, the role of the hospital must be one of readiness to serve the community should this threat materialize. Present knowledge of the effects of modern warfare upon a particular community are highly theoretical. Nevertheless, this threat remains. Our understanding of the effects of nuclear warfare indicates that, in its realization, the disaster health services and facilities of the Nation would face their most critical test. It is a well known fact that no community can be certain of escaping the effects of fallout. A better understanding of the implications of nuclear disaster will enable the responsible authorities to develop realistic community civil defense plans.

The detonation of a nuclear weapon produces four major effects, namely, blast, heat, initial nuclear radiation and residual radioactivity due to fallout. The first three effects will be limited to an area surrounding the immediate vicinity of the detonation. The fourth item, fallout radiation, could, however, affect practically the total population of the country.

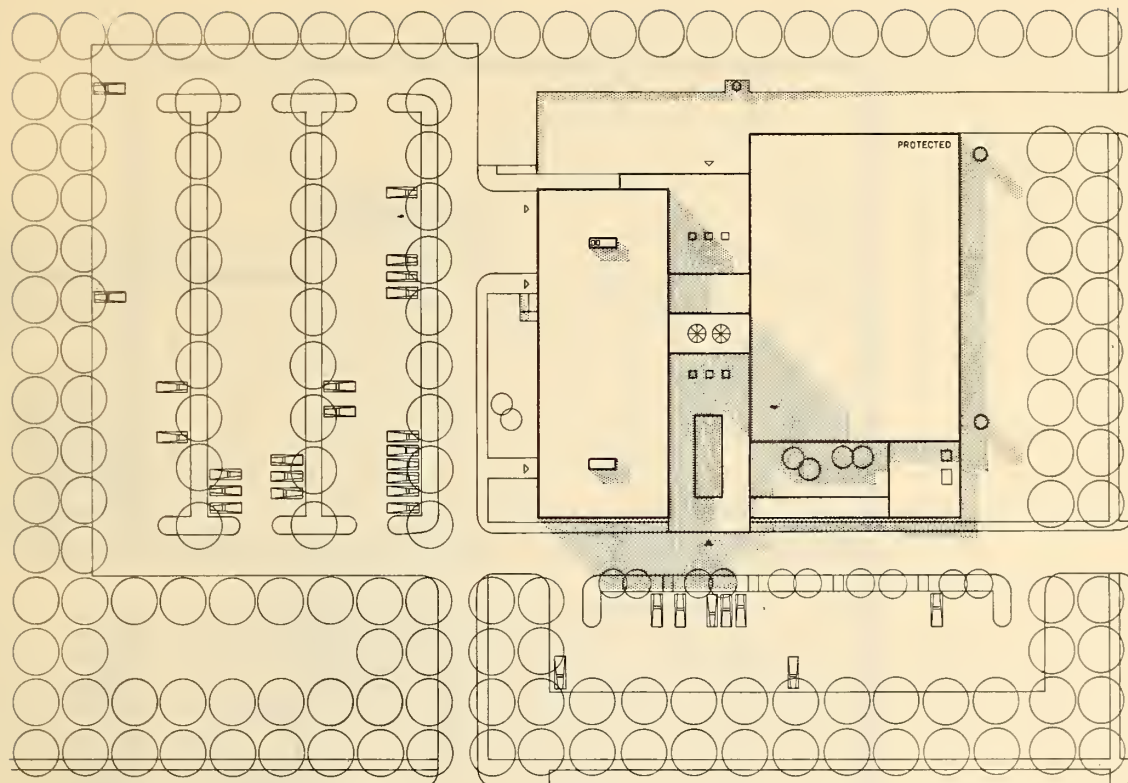
The National Shelter Policy, announced by the Office of Civil and Defense Administration in 1958, states as follows, "The Administration has conducted exhaustive studies and tests with respect to protective measures to safeguard our citizens against the effects of nuclear weapons. These several analyses have indicated that there is a great potential for the saving of life by fallout shelters. In the event of nuclear attack on this country, fallout shelters offer the best single nonmilitary defense measure for the protection of the greatest number of our people."

"The Administration's national civil defense policy, which now includes planning for the movement of people from target areas if time permits, will now also include the use of shelters to provide protection from radioactive fallout."

To implement this established policy, the Public Health Service has collaborated with Office of Civil and Defense Mobilization to develop criteria and standards for protective measures in hospitals.

CONSIDERATIONS FOR PLANNING PROTECTION

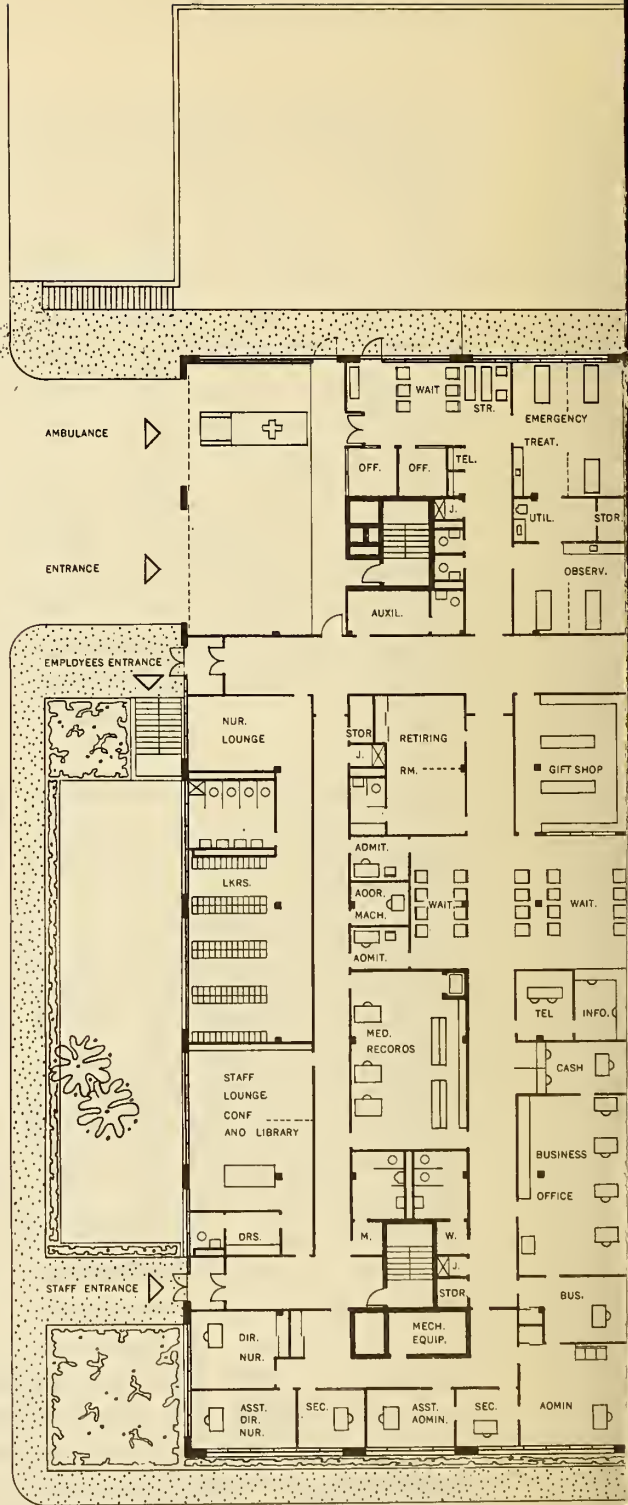
A prototype hospital of 150 beds was selected as a basis of design because it is typical of the size likely to be built in the periphery of an urban community or in the distant suburbs of a potential target area. Because of its location, the hospital would be spared the de-



SITE PLAN
SCALE 0 50

structive effect of blast and heat but could be subject to some fallout radiation. It was also felt that the 150 bed hospital would be the optimum size for presenting the complex normal problems of department relationships, traffic, and communications in conjunction with the essential features of shelter without obscuring the obvious characteristics of either. A fundamental requirement was that the protective measures must in no way impair the normal functional aspects of the hospital design. Therefore, the resulting design would be useful as a guide for planning a hospital with varying degrees of protection, from maximum to minimum, depending upon the determination of the community's civil defense program.

The protection of the patients and staff of the community hospital, while important, is only one aspect of total community defense. The existence of the protected hospital must be accompanied by a well conceived disaster plan which must be coordinated with the overall community plan for civil defense. Suggested arrangements for housing patients and staff are shown for this project, but the determination as to the patients, staff members, and other individuals for which the hospital will be responsible during a disaster is one to be made by appropriate local authorities. The extent of the clinical and other services to be protected, in addition to the space needed for housing, is also a local determination.

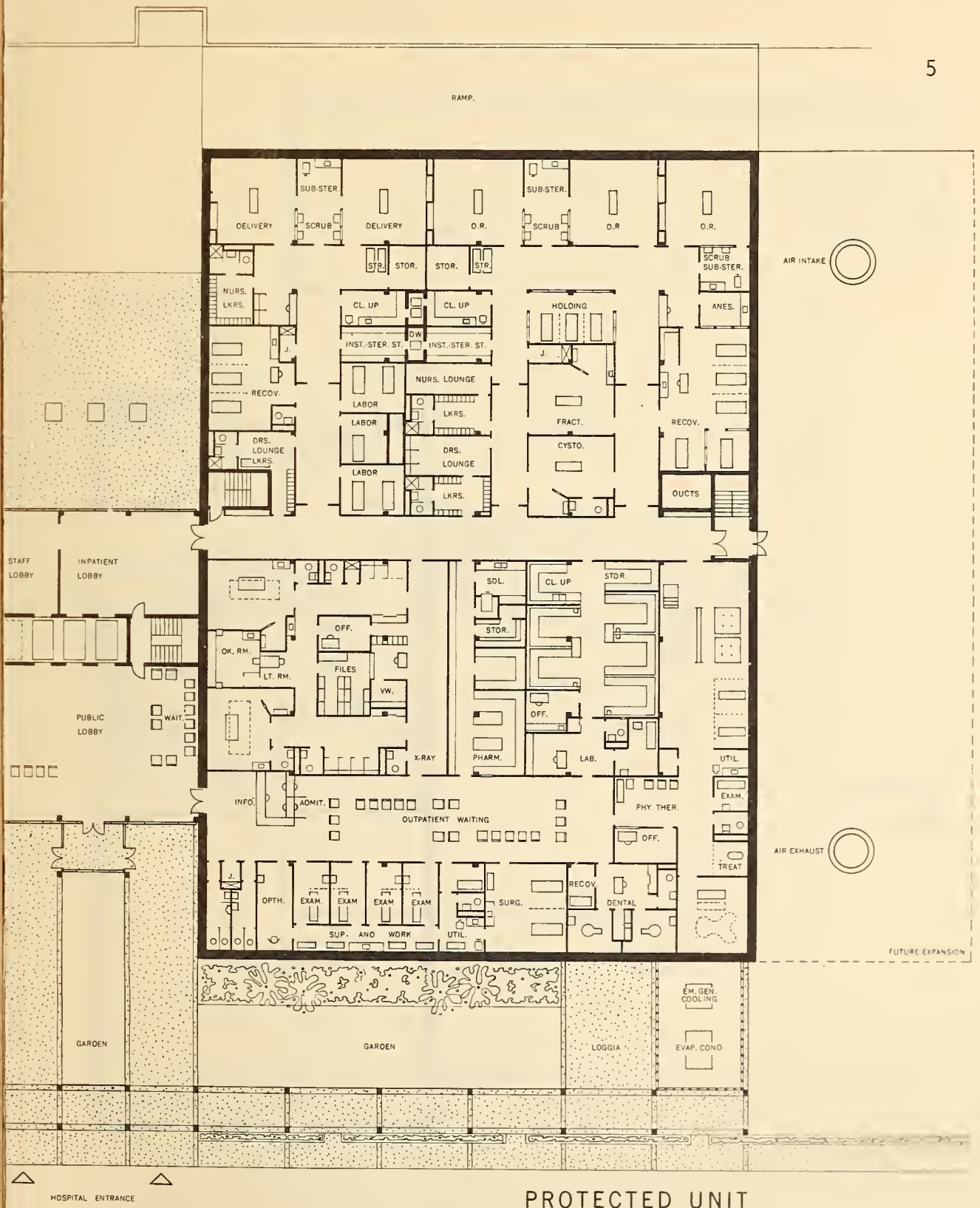


FIRST
GRAPHIC SCALE

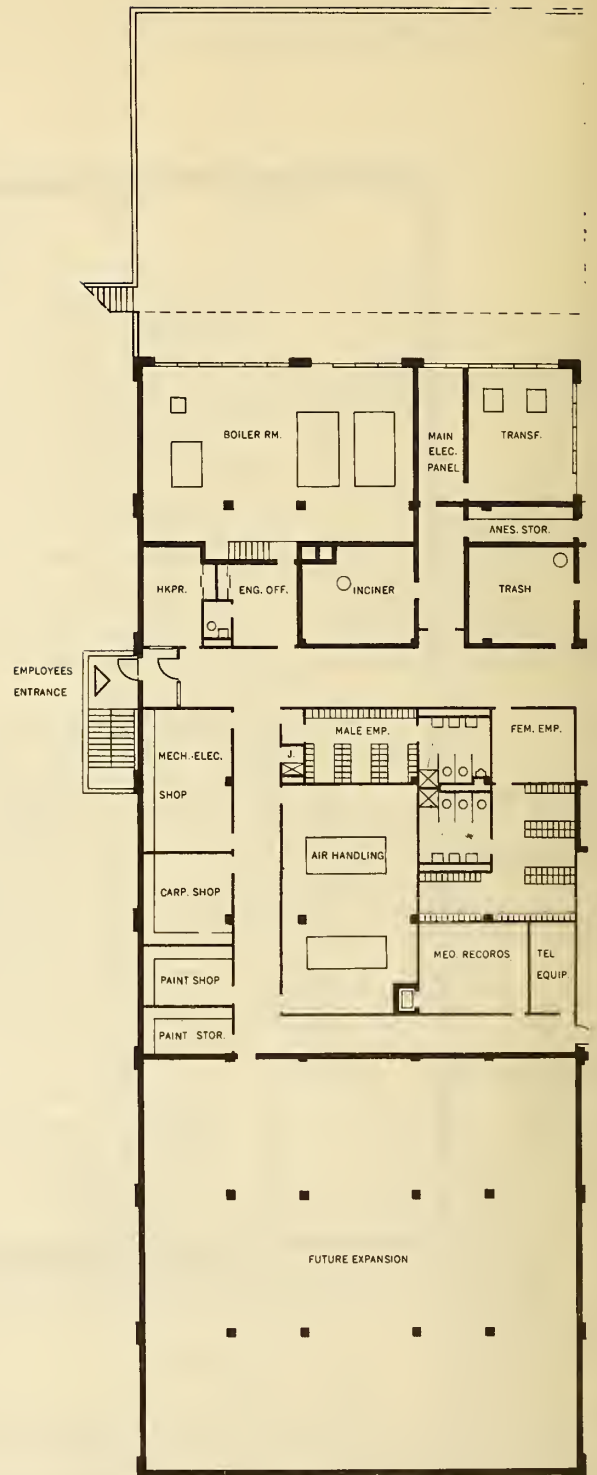
FLOOR

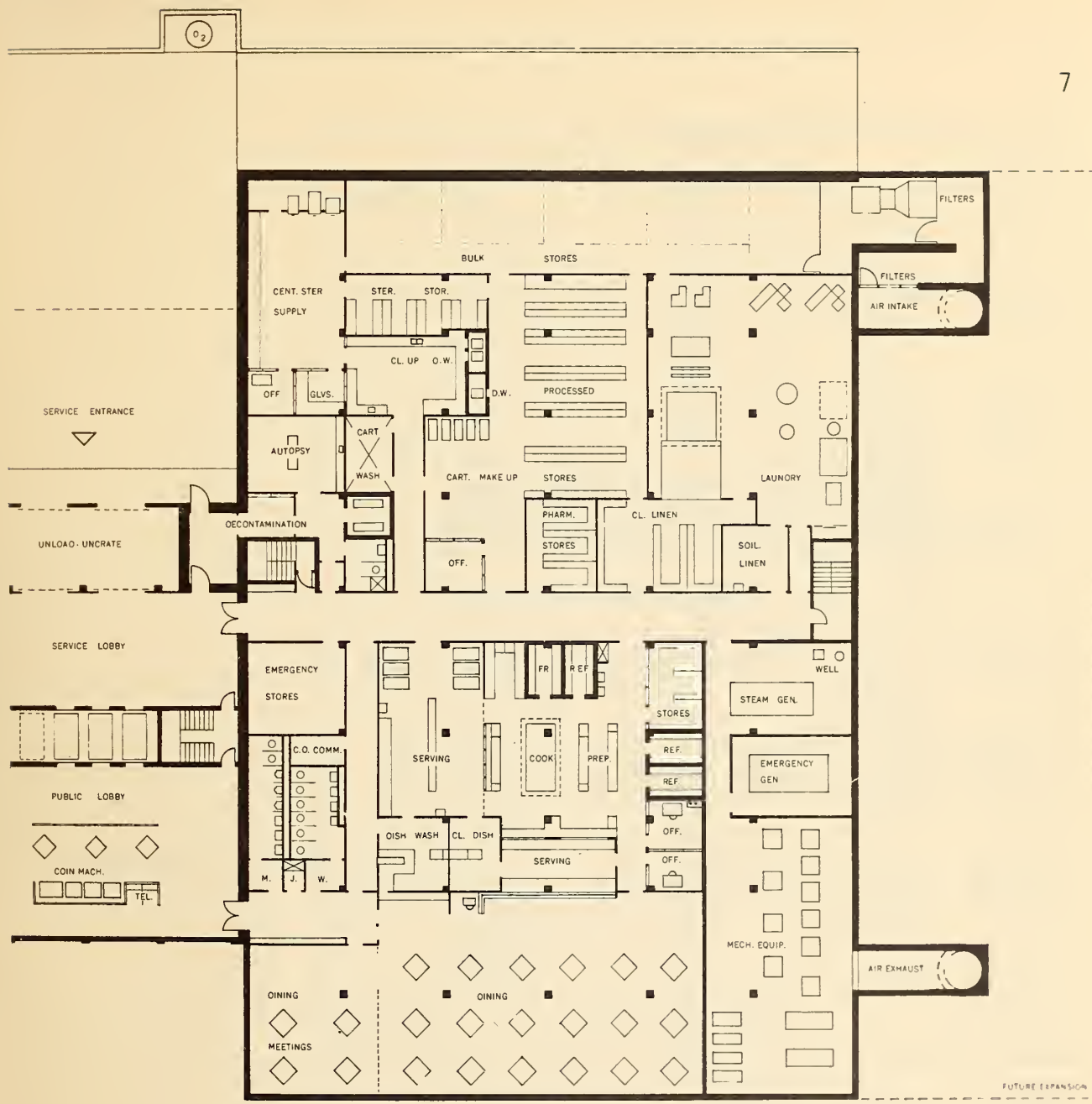
PLAN

FT. 0 8



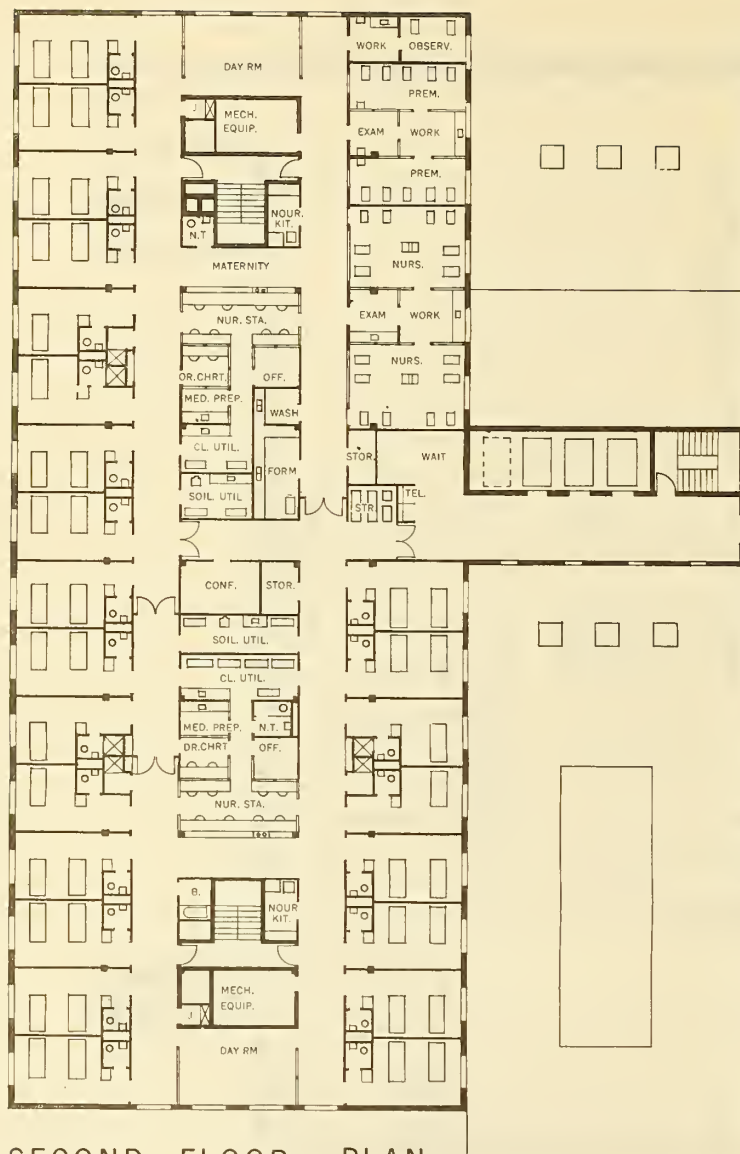
PROTECTED UNIT





PROTECTED UNIT

GROUND FLOOR PLAN
GRAPHIC SCALE FT 0 8 16



SECOND FLOOR PLAN

GRAPHIC SCALE

FT. 0 8 16

FUNCTIONAL ASPECTS OF THE HOSPITAL

This project presents a sound basic hospital of 150 beds designed to serve the needs of an average American community. It demonstrates that protective measures against fallout can be incorporated in the planning and construction of hospital buildings at reasonable cost

without sacrifice of functional or operational requirements.

The hospital is basically composed of a protected unit and an unprotected unit joined by a circulation unit containing connecting corridors and elevators.

The protected unit contains only those elements whose function or



THIRD FLOOR PLAN

use would not be jeopardized, in any manner, by being located in a windowless environment. For example, the concept of placing clinical and diagnostic areas in a windowless structure is already widely accepted as an efficient planning arrangement. Similarly, the service facilities, central sterilizing and supply, stores, laundry, and dietary are located on the lower floor of the

protected unit in a manner consistent with normal practice. These areas provide ample space for the maximum population of the hospital and, in fact, will permit limited shelter capability for others commensurate with the requirements of the community civil defense plans.

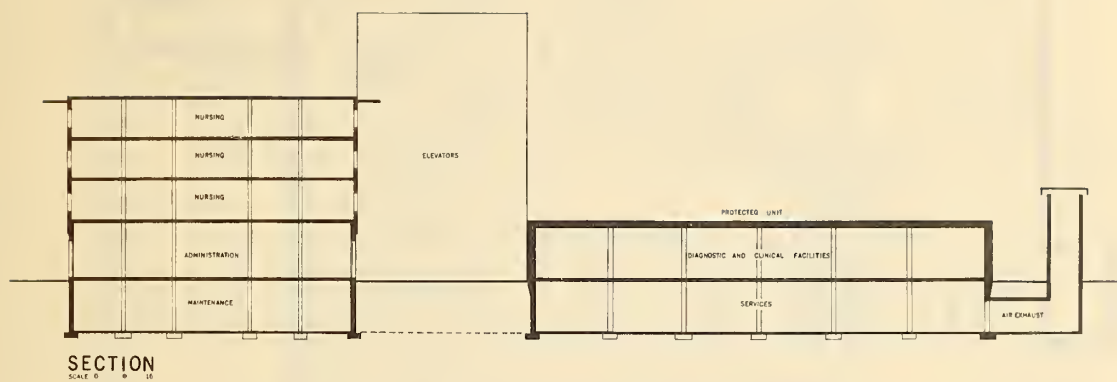
Since the administrative areas are closely interrelated with the main



FOURTH FLOOR PLAN

entrance and lobbies which are generally arranged for easy access from the street, these areas are placed in the unprotected unit of conventional construction. The nursing units are similarly located because of present building code requirements as well as widespread public prejudice against windowless patient rooms.

For shielding purposes, access openings into the protected unit are limited to the minimum necessary for functional use. On the first floor, the public enters the outpatient department with ready access to x-ray, pharmacy, laboratory and physical therapy. The other entrance is limited to staff and inpatients and leads to surgery, obstetrics and the



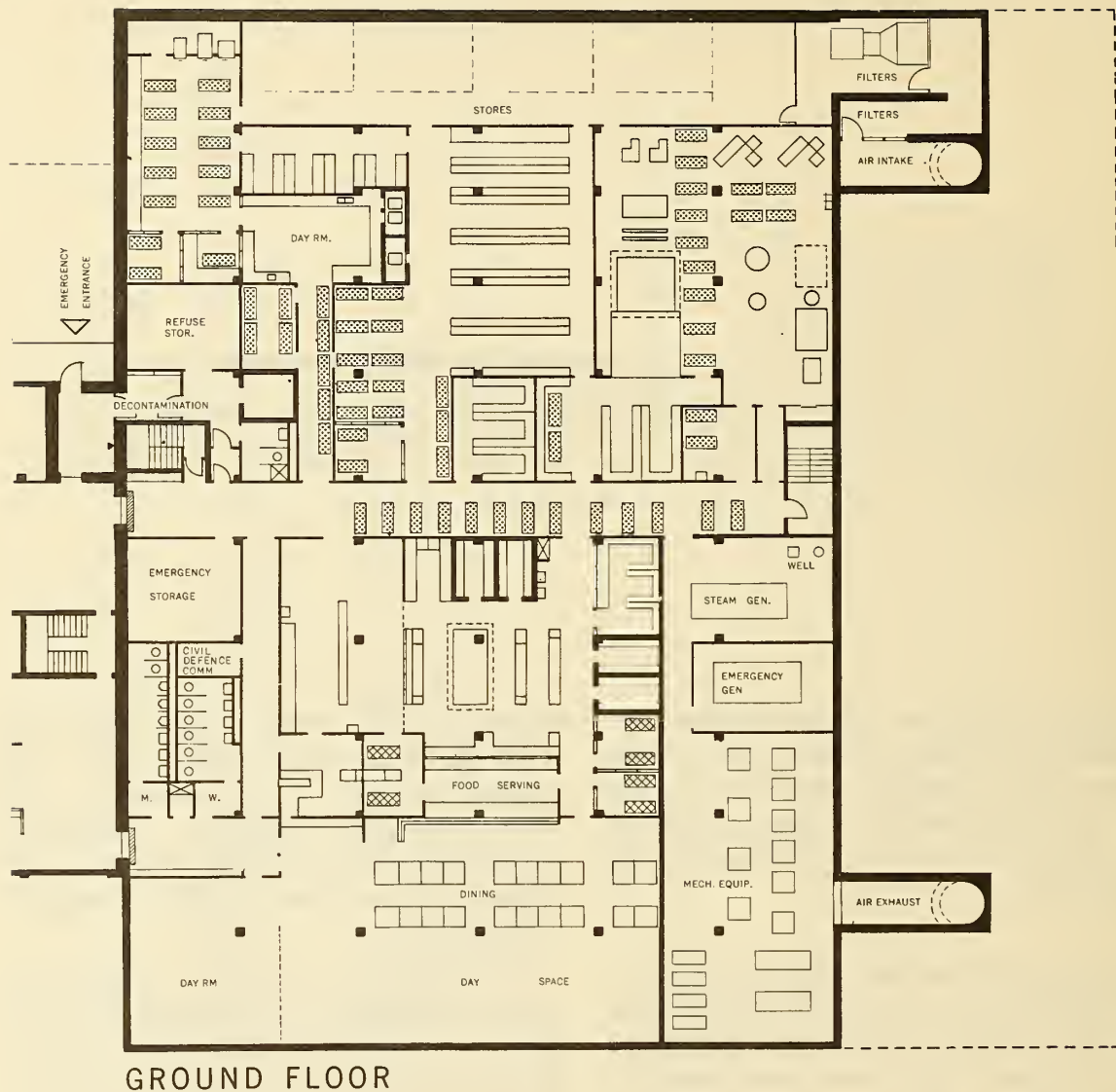
clinical services common to the out-patients. In like manner, the lower floor has a public entrance to the dining facilities and a separate door for service and housekeeping functions.

During the period of fallout emergency, all main doors to the protected unit will be closed and access to and egress from this structure, if necessary, will be via the autopsy and morgue. This is arranged with air locks and suitable washing facilities to permit the radiological decontamination of individuals who may have been subjected to the fallout environment.

The site plan is designed to separate service traffic from staff, employees, and visitors. Convenient parking is provided for visitors near the main entrance and the overflow, if any, can be accommo-

dated in the main employees and staff parking area at the side. The judicious use of landscaping and tree plantings serve to minimize street noise and dust as well as improve the view of the hospital occupants.

Flexibility to permit expansion was seriously considered in this plan. The dotted lines on the plans of the protected unit indicate logical directions for increasing the clinical and service departments, and this construction may be protected or unprotected as deemed necessary. The surgery department could be expanded into the obstetrics area which could be placed on the second floor of the protected unit along with a future maternity and nursery department. Additional medical and surgical nursing units could be constructed over the new obstetrics unit as well as over the existing nursing units.



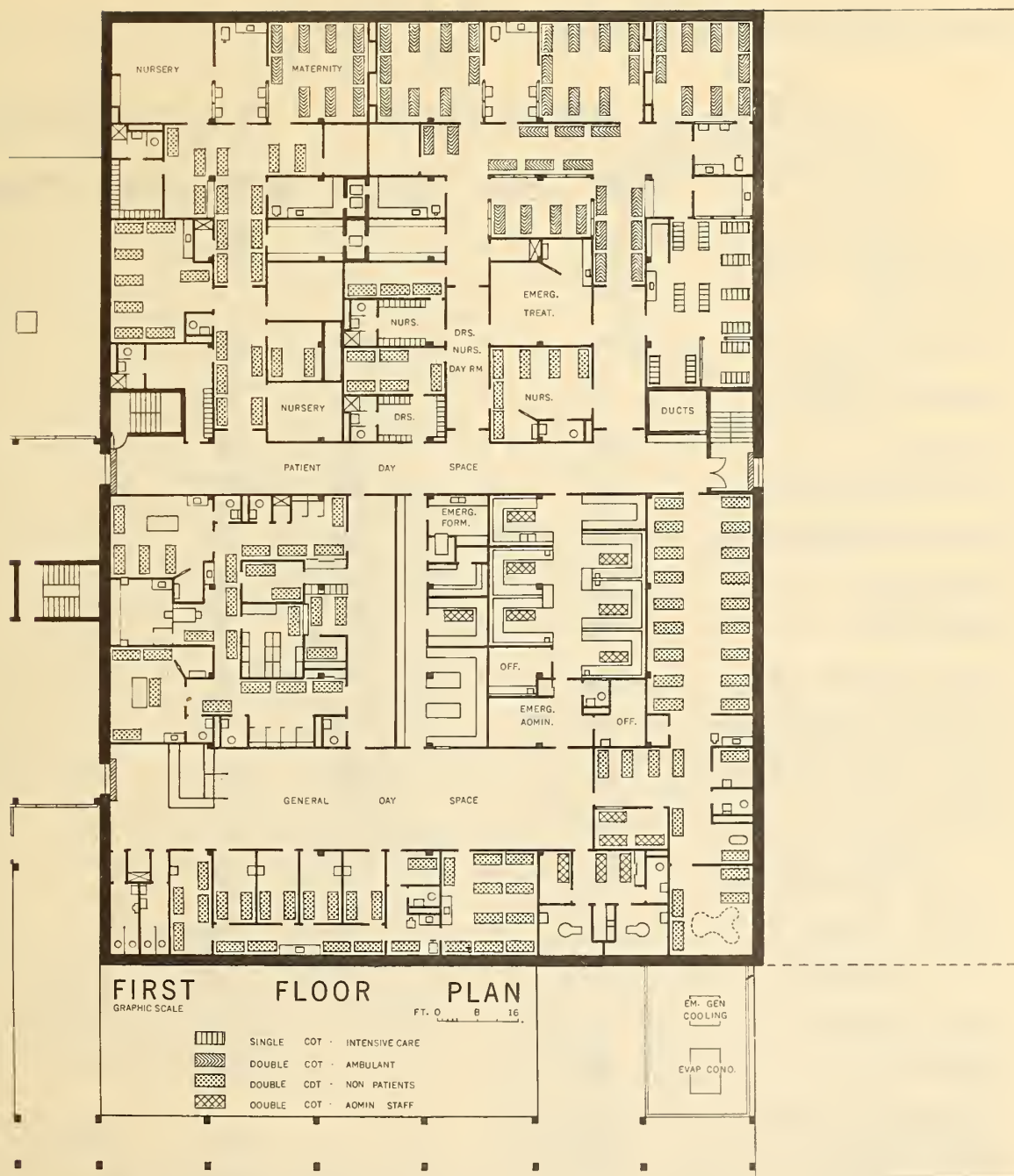
SUGGESTED SLEEPING ARRANGEMENTS FOR EACH FLOOR OF
THE PROTECTED UNIT OF THE GENERAL HOSPITAL ACCOMMODATING A TOTAL OF 750 PERSONS.

SHELTER SPACE

In the event of nuclear attack, under normal weather conditions, significant amounts of fallout do not arrive outside the blast area earlier than about one-half hour after the explosion. It is reasonable, therefore, to assume that a hospital (if

located outside the blast area) would have some time to prepare for the fallout emergency if promptly notified of a nuclear attack.

Upon such warning, all patients, staff, and others in the unprotected



wing of the hospital would be evacuated to the protected area. The door closures consisting of loose keyed masonry blocks would be arranged to seal the door openings. The mechanical and electrical systems would be switched on to the pre-

designed civil defense emergency operating condition, and sufficient cots would be set up to accommodate the number of persons to be sheltered. Based on the usual civil defense requirements, it is assumed that the fallout emergency situation

HOSPITAL OCCUPANCY TABLE

	<u>NORMAL STAFF</u>			<u>PEAK POPULATION</u>		
	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>
ADMINISTRATIVE	20	4	16	18	3	15
X-RAY	7	4	3	7	3	0
NURSING	105	5	100	52	2	50
LABORATORY	9	5	4	9	5	4
DIETARY	24	4	20	18	2	16
HOUSEKEEPING	28	14	14	21	10	11
PLANT OPERATION	10	10	0	7	7	0
LAUNDRY	10	2	8	10	2	8
PHARMACY	2	1	1	2	1	1
OUTPATIENT DEPT.	7	2	5	7	2	5
PHYSICAL THERAPY	2	1	1	2	1	1
CENT. STER. SUPPLY	10	0	10	10	0	10
PHYSICIANS OB	5	5	0	2	2	0
SURGERY	20	20	0	10	10	0
GEN. PRACT.	20	20	0	10	10	0
OTHERS	7	7	0	3	3	0
VOLUNTEERS	3			5	0	5
VISITORS	20			20	10	10
OTHERS (SALES, SERVICE)	10			10	10	0
OUTPATIENTS	20			20	10	10
AMBULANT POP.	341			243	94	149
INPATIENTS	120			120		
TOTAL	461			363		

may last as long as two weeks and sufficient food, fuel and other supplies should be stored for this time interval.

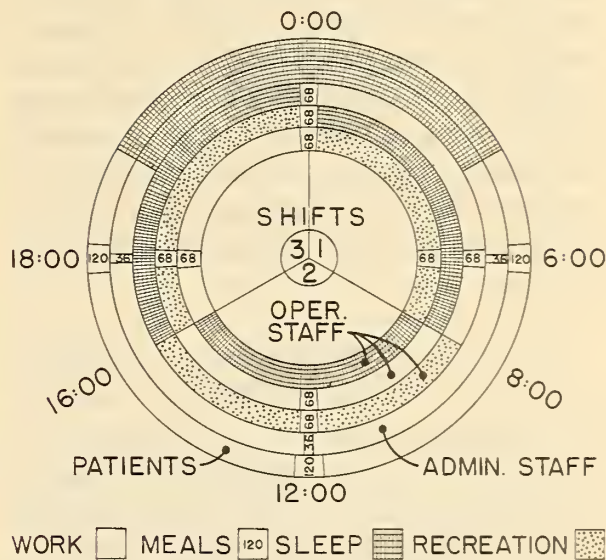
Since an attack may occur at any time, the hospital should be prepared to act without undue delay and be able to provide shelter accommodations at least for all individuals within the hospital at the time of the alert. A study of the peak population of a 150 bed general hospital is estimated to be 363 as outlined in the accompanying table and this would serve as an indication of the minimum arrangements that should be provided. The type of basic hospital plan selected would strongly influence the extent of the protected area that would be available. On this project, for example, it is possible to protect the entire clinical-diagnostic-service unit and to accommodate a total of about 750 people at little additional cost over the amount required to provide protection for the bare minimum population. This additional capacity could be an important adjunct to the community civil defense program by providing the capability for sheltering additional hospital and medical personnel and the public.

SLEEPING

Single cots are provided for the critically ill patients whose medical condition indicates the need for intensive nursing care. The remaining patients would be assigned to double-deck cots.

The administrative staff of the hospital would be on call around

OPERATIONAL SCHEDULE OF SHELTER ACTIVITIES



THIS CHART DEPICTS A SUGGESTED ROUTINE FOR THE DAILY ACTIVITIES OF THE SHELTER INHABITANTS BASED ON DIVIDING THE DAY INTO THREE EIGHT-HOUR SHIFTS.

the clock during the shelter emergency, and it is recommended that they be assigned permanent spaces in double deck cots. All other non-patients would be organized on a three-shift per day program of work-rest-sleep and three persons would be assigned to each double-deck bunk unit for sleeping purposes. This would tend to eliminate the 'hot bunk' problem without requiring excessive sleeping accommodations. Bedding (a sheet or unlined sleeping bag) would be furnished each occupant in a kit that would also contain a number of indispensable personal hygiene items.

SHIELDING

Utilizing the principles outlined in this project, any degree of protection from fallout radiation commensurate with the community civil

defense plan can be incorporated in the hospital design. The specific shielding requirements for a particular hospital should be evaluated by the local authorities on the basis of its location with respect to probable target areas, direction of prevailing winds, potential for evacuation, and other civil defense oriented factors.

For this study project, a radiation protection factor of 1000 was adopted for the protected unit. This would be adequate for the heaviest fallout areas. As a result, the exposed wall construction is equivalent to a mass thickness of 315 pounds per square foot (about 26 inches of concrete) and the roof is 230 psf (about 20 inches of concrete). If a lesser shielding value is selected, a lesser thickness of wall and roof construction would then be required. Since the requirements other than shielding (i.e., mechanical, electrical, and architectural) will be the same for all degrees of fallout protection; it is readily apparent that the protection capability is controlled by the amount of shielding provided. Because small increases in mass thicknesses which produce large increases in shielding are comparatively inexpensive, the ultimate cost of better protection from fallout is insignificant.

A vital factor in obtaining a reasonably uniform shielding value throughout the protected unit is to plan it with as few openings to the outside as possible. It is difficult to protect doors, windows, stair towers, elevator shafts and simi-

larly large openings with any efficiency. A circuitous entrance pattern or maze will reduce radiation penetration (although not to the same extent as a direct closure) but does impose the problem of hindering traffic flow. Direct closures of exterior wall openings by temporary baffle walls or massive doors, on the other hand, can be made as effective as the basic wall construction without affecting traffic in any way.

Since efficient traffic patterns are a functional requirement in hospital planning, it is recommended that the direct closures of exterior wall openings be used. Temporary baffle walls are more practical from an economic point of view when a high degree of shielding is specified, and were, therefore, used in this study project. Heavy doors would be more suitable when the specified radiation reduction factor is of a low order.

The elevator and stair shafts were removed from the protected unit without sacrifice to hospital function, thereby eliminating the need for any protective measures in connection with these elements.

FOOD

Since the dietary department including food stores is in the protected unit, all food reserves in the hospital at the beginning of the alert would be available for use during the civil defense emergency. Under an average hospital's normal purchasing policy, this stock of food

supplies, when rationed to the shelter occupants at subsistence levels, might last as long as a week. This means that prepacked food rations, strictly for emergency use, would then have to be furnished for only another week. Cooking should be kept to a minimum, being limited to soups and beverages warmed on the electric cooking appliances.

For maximum utilization of working personnel and facilities within a normal three meals per day schedule, food can be served every six hours around the clock as indicated on the shelter operational chart. Except for bed-ridden patients, cafeteria style serving lines using single service paper plates and cups are recommended if sufficient water is not available for washing dishes.

ELECTRIC POWER

Electric service for a protected hospital of the type described herein operates in the same manner as for an ordinary nonprotected hospital. Occasional interruption of the utility service is expected for any hospital during the normal course of time and events. An emergency electric service, usually of limited capacity, is required for all hospitals to assure continuity of critical functions within the hospital. Many public utility service facilities will not be protected against fallout radiation; hence it must be assumed that such services will not be available during such an emergency. Accordingly, emergency electric generating facilities must

be installed in the protected sections of the hospital and must be of sufficient capacity and have the correct electrical characteristics for operation of the selected lighting, pumps, fans and other essential motorized equipment, and for cooking or warming food. A supply of fuel and lubricants for operation of the generating unit at full load continuously for not less than two weeks should be provided.

This hospital is divided into two principal sections, one section protected against fallout radiation, the other an unprotected section. During an ordinary interruption of the utility service, the emergency service would be connected in both the protected and the unprotected sections. During fallout conditions, the emergency service would be disconnected from the unprotected section. The emergency electric capacity thus saved could then be applied in the protected section to operate additional equipment not emergency operated during an ordinary short time interruption of the normal utility service. It is expected that the emergency power capacity required for operation of the protected section alone, under fallout conditions, would be approximately equal to the total required for operating both protected and unprotected sections during ordinary short-time interruptions of utility service.

In both the protected and the unprotected sections of the hospital, the selected lighting circuits should be automatically connected to the

emergency service when the normal service is interrupted, but motors, except fractional horsepower motors, should be arranged for manual starting in such a sequential manner as not to overload the generator. Overload protection of feeders should be so provided that an internal fault in one section of the hospital will not cause an interruption of service in the other section.

It is recommended that consideration be given to providing circuitry to permit convenience of alternately operating certain equipment and also for possible future connection of additional generating capacity.

AIR

The normal air components for physical comfort and well being with which we are primarily concerned are oxygen, carbon dioxide and water vapor. However, not to be overlooked in the overall planning are such toxic, noxious, and pathogenic constituents as: chemical, biological and radiological warfare agents, carbon monoxide, combustible gases and odorous substance.

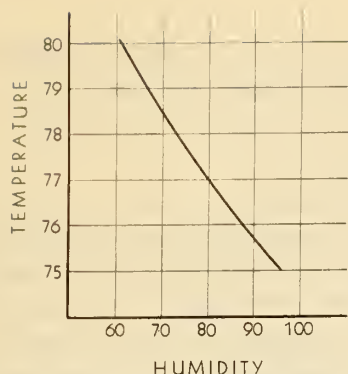
The capacity of the air conditioning system provided for the average modern hospital will usually exceed the requirements for shelters. However, certain modifications are required to adapt the system for shelter use. Air purity, temperature and humidity must be kept at suitable levels during the emergency. The totally enclosed nature of the shelter spaces and their com-

paratively high occupancy during the emergency means that air conditioning including cooling will be a requirement in most areas of the United States.

Temperature and humidity must be maintained within reasonable comfort levels, particularly for the benefit of hospital patients. Effective temperature, which is an arbitrary index representing the effect of warmth or cold felt by the human body is the best available index of ambient atmospheric conditions in relation to the physiological response of man. An effective temperature not to exceed 75° is recommended for hospital shelter areas. This provides a range of temperatures and humidities somewhat above normal design practice for comfort but well within tolerable limits.

Although the broad emphasis has been placed upon fallout protection, it is strongly recommended that sufficient space should be provided and the design of the ventilation system should permit the installation of a combined chemical, biological and radiological (CBR) filter unit. The system should be designed to permit the bypassing of all outdoor air through the CBR filter unit during the emergency to provide additional protection by removing gas and bacteriological warfare elements.

In view of the space requirements of the CBR filter units, it may be desirable to hold the introduction of outdoor ventilation air to a minimum.



THIS GRAPH REPRESENTS THE COMBINATION OF TEMPERATURE AND HUMIDITY CONDITIONS REPRESENTED BY AN EFFECTIVE TEMPERATURE OF 75°.

Oxygen and carbon dioxide must be maintained at suitable levels. This may be accomplished by the introduction of outdoor air. Oxygen replenishment from normally stored supplies is not recommended for emergency periods, although if available, should not be overlooked as a reserve resource. Absorption or closed regenerative systems are not recommended for maintenance of oxygen and carbon dioxide levels when outdoor air is available.

Minimum outdoor air ventilation rates to maintain suitable levels of oxygen and carbon dioxide are dependent upon the per capita space allotment of the shelter area. The accepted rate for mass public shelters is 3 cfm per occupant, per hour, for normally healthy persons. However, because of the physical condition of many of the occupants of the hospital shelter and because of the specific ventilation requirements of certain clinical areas, which may be active during the emergency, a minimum of 5 cfm per person, per hour of outdoor air is recommended for hospital shelters.

Higher ventilation rates are desirable to provide greater flexibility in controlling the air pressurization of the shelter area which is necessary as a protection against the infiltration of contaminants. Higher ventilation rates will also contribute to odor control. Where the air supply is limited to the minimum activated charcoal filters installed in the ventilation system are recommended for odor control.

Good hospital design assumes good filters in the normal outdoor air intake ventilation systems. Filters with a minimum of 80 percent efficiency according to the National Bureau of Standards "Dust Spot Method" of testing offer ample protection against radiological fallout particles. An abrupt change of direction of air flow after entering the intake and prior to the filters will materially aid in deposition of large contaminated particles, thus reducing the filter load. As the settling chamber and the filters may become highly contaminated with radiological particles, it is mandatory that a protective barrier be interposed between them and the shelter area.

To maintain the boiler and electric generator rooms uncontaminated for the operating and maintenance personnel while supplying combustion air for this equipment, normal exhaust air from selected areas within the shelter may be bypassed through these rooms.

As no filters have been devised which will remove carbon monoxide, it is important that outdoor

air inlets be remotely located from any possible source of fire such as adjacent combustible buildings.

Evaporative condensers are recommended for the discharge of heat from the shelter air conditioning system to eliminate any possibility of carrying radioactive contaminants into the shelter through the cooling system.

WATER SUPPLY

Because of the possibility of radiological contamination of public sources of water supply such as impounded reservoirs, rivers and water sheds, and because of the possible destruction or contamination of community distribution lines, it is essential that a reliable source of water be provided for the emergency. Ground water, which is available in a large part of the country, offers a ready solution to the problem, in that wells can be developed within the shelter area.

A well, in addition to providing safe water may eliminate the need for restricting water usage for domestic purposes. Where the water from a well source is not potable, consideration should be given to its use for sanitary purposes such as cleaning, toilet flushing, etc. In this case, storage must be provided for a minimum of 1 gallon of potable water per occupant per day. This storage must be placed in series in the regular distribution lines to insure continuous turnover of the

water so that it will be fresh at the beginning of the emergency.

HEATING

Boiler rooms are usually designed with large windows and other openings to provide light and ventilation. These openings make the boiler room a particularly hazardous and untenable area in case of radioactive fallout. Proper operation and maintenance of this vital equipment may be impossible under certain fallout conditions. (Unprotected public utility services may suffer from similar circumstances.) For this reason, an emergency source of heat must be provided. There are two methods of providing this heat which merit investigation: (1) Diesel engine electric generator heat loss recovery and, (2) a small emergency boiler. Of the two heat sources, the boiler is more adaptable to hospital operation. Under usual conditions it is recommended a small high pressure boiler be installed within the protected area for use during the emergency period. Some designs may lend themselves to a normal usage of this boiler, but for economy in design and operation, under most circumstances, this boiler would serve only for the emergency period. The capacity of the boiler should be kept to a minimum to serve only those vital functions required during the emergency, such as: space heating, water heating, and operating a sterilizer.

Because of the high density population and the confined nature of the shelter area, space heating regard-

less of the season will be a minimal load. Heat requirements will usually be supplied through the ventilation system. The hot water load will depend upon the availability of a water supply and may therefore vary in different areas of the country. Where water supply is dependent upon hospital storage facilities, austerity will be invoked and the boiler load will probably be considerably less than where a well water supply is available. During the early stages of fallout and confinement, it is anticipated that the sterilization needs will be taken care of by one pressure sterilizer.

Oil is recommended as the emergency period fuel because of the ease of storage of an ample supply for the emergency period and because it eliminates dependence upon an outside source of supply. Where a boiler is installed solely for use during the emergency, consideration should be given to combining the storage of boiler and the emergency electric generator fuel oils. This would provide some turnover of the stored oil and place it under more constant supervision.

SANITATION

Provision for the disposal of rubbish and human waste must be carefully planned. A certain amount of rubbish in the form of garbage, heavy cartons, bottles and cans will pose the greatest problem. The use of garbage grinders for the disposal of food waste and the use of incinerators for the disposal of food waste and rubbish should be explored.

However, garbage grinders are dependent upon an ample supply of water and incineration is not effective for bottles and cans. A rubbish storage room located within or adjacent to the decontamination area offers a solution to the problem. This area will not be a part of the general circulation area for the population, and storage there would not be objectionable. It is anticipated that as outdoor levels of radiation intensity decrease, it will be possible to periodically remove the accumulation of waste materials to the outdoors.

PLUMBING

The plumbing system for the hospital shelter area poses no particular design problems. Where the shelter area is a part of the normal hospital, water, sewer, gas, oxygen and other service distribution systems will serve both the shelter and the non-protected portions of the hospital. In such cases, in so far as possible, a grouping of these systems at one point of entry to the shelter area with cut-off valves within the shelter, will facilitate shutting off these services to the unused portion of the hospital, if necessary, at the time of the emergency. Where a well is available, the normal water distribution system will be cross-connected with the well system.

Where well sources are available, the use of flushing type fixtures is recommended for human waste. Chemical type toilets will usually be required in situations where no

well source is available and it is necessary to store potable water.

Toilet facilities for hospital shelters are recommended as follows:

Water Closets	1 for each 25 patients and 1 for each 35 non-patients
Lavatories	1 for each 35 persons
Shower Baths	1 for each 60 patients and 1 for each 120 non-patients

Because local sewage disposal facilities may not be protected against radiation and therefore may not be staffed or in operation during the emergency, it is necessary to provide a means for removal of sewage. For this purpose, it is recommended that a bypass from the normal building drain be made to a sewage sump within the shelter from which sewage may be pumped to the outside. Where chemical toilets are required, their contents may be periodically disposed of through the sewage sump.

Leaders for conducting rain water from roof surfaces should not pass through the shelter area because of the danger of creating hot spots in the conductor system in case of rain during the emergency.

COST

A major objective of this study is to demonstrate that protective measures against fallout can be incorporated in the planning and

construction of hospital buildings at reasonable cost. Although true cost figures are singularly elusive under normal circumstances, they tend to be particularly so in a study where comparative costs must be determined without benefit of definitive contract prices. However, preliminary construction cost estimates, based on mid-1960 costs in the New York City area, have been completed and indicate that the cost of constructing the prototype hospital incorporating protective measures as described herein would probably be in the range of three to five percent more than the cost of a similarly planned hospital of conventional construction that would be completely air conditioned.

The low additional cost can be attributed to a number of factors:

- 1) Little additional space is required solely for protective purposes. Only space for the storage of emergency supplies (food, cots, etc.), civil defense communications, emergency boiler, air intake and filter, and air exhaust, is in excess of that required for normal hospital purposes.
- 2) Little additional equipment is required solely for protective purposes because a hospital is well supplied with mechanical and electrical equipment that is readily convertible for shelter use.
- 3) The hospital areas involved permit a high degree of efficiency in providing maximum shelter capability.

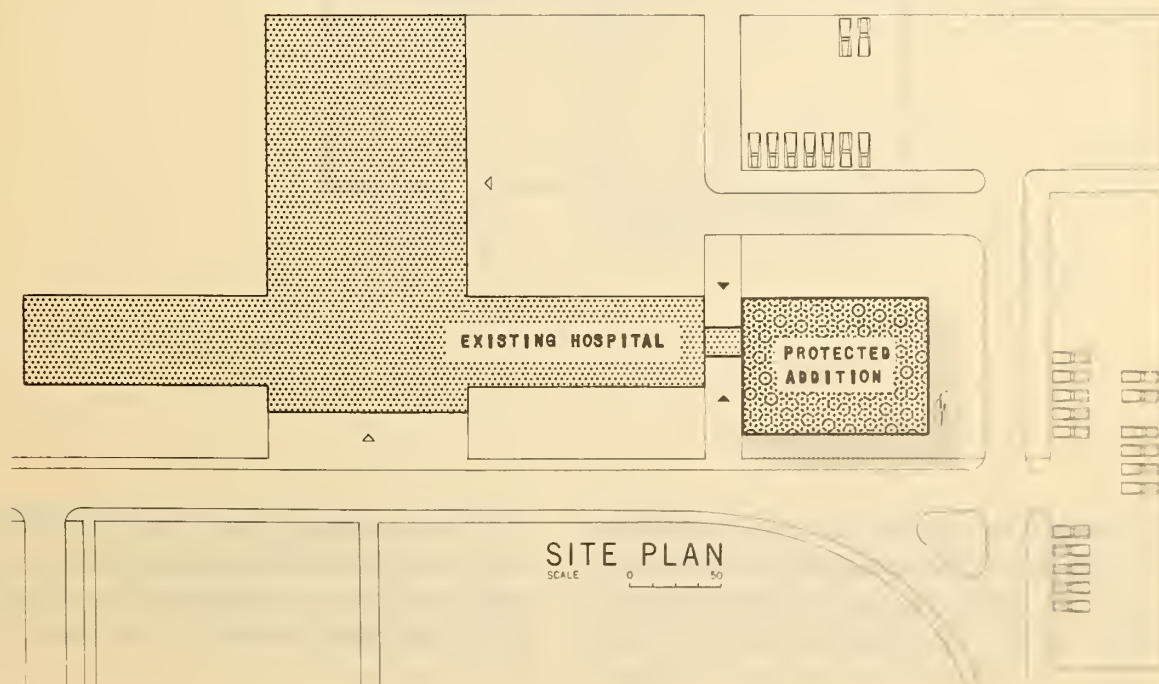
PROTECTED ADDITION TO AN EXISTING HOSPITAL

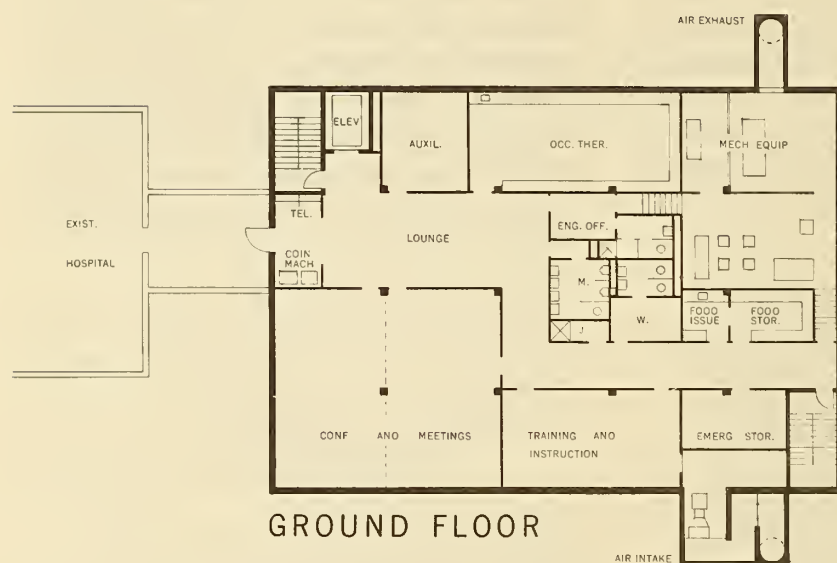
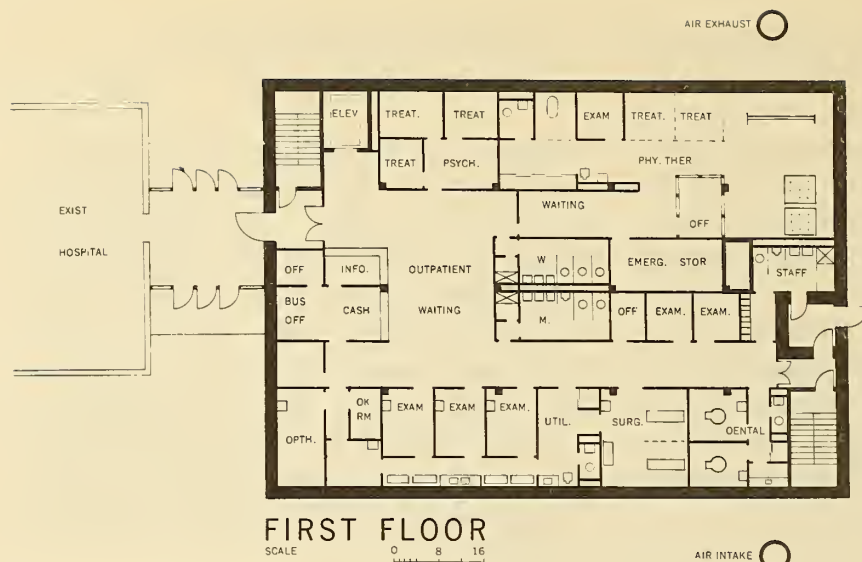
A satisfactory nation-wide program of protected health facilities obviously cannot be achieved in a reasonable time by the construction of new protected hospitals. Therefore, the role of the existing hospital in this respect becomes very important. The implications of incorporating protective measures to the expansion of existing hospitals has been studied.

Since the planning requirements for each addition would vary with each hospital, it is difficult to propose very specific planning recommendations. Whether or not an addition could be designed with all the requisites for fallout protection with the high efficiency of a new hospital would ultimately depend upon the

kinds of services to be located in the addition. In some instances, space in excess of immediately planned needs may be necessary to fulfill the protective requirements for fallout. In these cases, areas such as meeting rooms, training facilities, etc., which are difficult to justify on a hospital's tight budget, might be acceptable when used in connection with the shelter program.

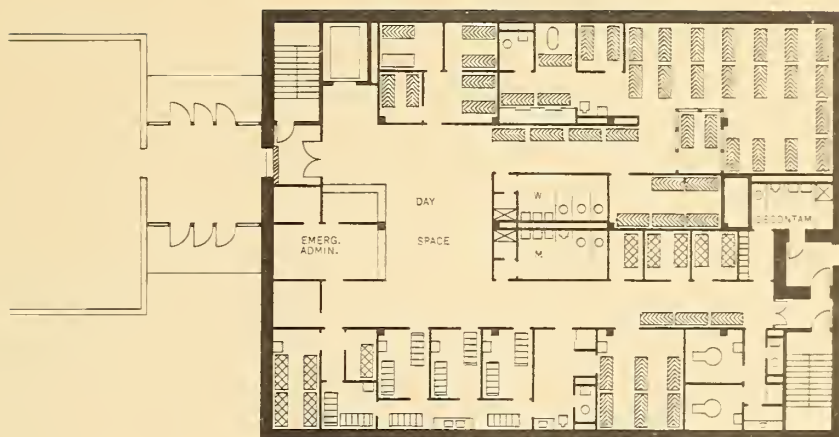
The services selected for the prototype addition to an existing 150 bed general hospital were found to be commonly lacking or greatly outgrown in many present hospitals. They are also highly efficient from a shelter point of view and, because of this, the protected unit shown is





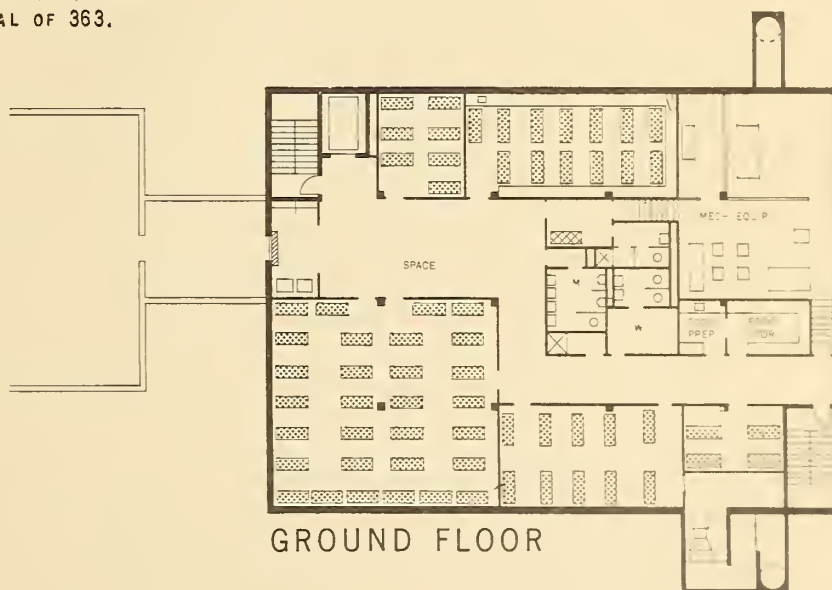
probably as small as can be devised to house the scheduled peak population of 363. In all probability, if other types of hospital services are used, a larger area will result.

The shielding, sleeping, electric, and mechanical characteristics of this project are essentially similar to those discussed in the new hospital project.



FIRST FLOOR

SUGGESTED SLEEPING ARRANGEMENTS FOR EACH FLOOR OF THE PROTECTED ADDITION TO AN EXISTING HOSPITAL ACCOMMODATING A TOTAL OF 363.



GROUND FLOOR

Preliminary cost figures have not been developed sufficiently for presentation and discussion at this time but it appears that the relative cost

percentage of the addition would be in a higher range than that discussed for the new hospital project.



